Responses of the healthy equine carpal joint to treadmill exercise

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We investigated the effects of treadmill exercise on synovial fluid (SF) biomarkers and range of motion (ROM) of the carpal joints in healthy Shetland ponies. Seven ponies (age 3-6y; acclimatised to treadmill), were trained five days/week for five weeks, complemented with 30 min (30') daily walking exercise. Training consisted of 4' trot (16 km/h), 2' canter (21 km/h), 2' trot (preceded and completed by 5' walking at 4.4 km/h). SF was collected from left (LF) and right (RF) middle carpal joints three days before the first and 24 h after the last training session (Day33), and additionally from the left side at Day11, -12, -32 and -52. Cartilage metabolism markers CPII, C2C and GAG, and inflammatory markers PGE2.D2, CCL2, and MMP were measured. Carpal ROM was measured using 3D optical motion capture (Proreflex 240, Qualisys, framerate 200 Hz), on the treadmill at Day2 and Day25. Linear mixed models were used for statistical analysis, with significance set at $P<0.05$. After five weeks, mean SF CPII had doubled significantly (+102%) and GAG levels decreased (-25.9%, $P=0.054$) RF. Repeated arthrocentesis within 24 h LF caused significant increases in CCL2 levels (+334% Day12; +418% Day33) and MMP activity (+180% Day33). Carpal ROM decreased at walk and trot LF (50.2-6.59° walk; 70.5-10.1° trot, $P<0.001$) and RF, though not significantly (45.3-5.66° walk, $P=0.06$; 63.5-5.83° trot, $P=0.08$). When treadmill exercise is used in OA or lameness models, effects of exercise itself on outcome parameters should be discriminated from impact due to interventions such as joint trauma, therapy, or lameness induction.

The effect of fibre in equine arena surfaces on shear ground reaction forces

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Shear forces at the surface-hoof interface affect hoof slide, forces transferred to the limb, and injury risk. However, shear ground reaction forces have been measured on only a few surfaces. Shear properties of 12 dirt and synthetic arena surfaces were quantified to determine the influence of surface composition on shear ground reaction forces. Linear shear ground reaction forces were measured with a surrogate hoof and steel horseshoe on 5 dirt and 7 synthetic arena surfaces at a constant velocity of 0.017 m/s for 5 vertical loads (215.2 N-1.030.8 N). Dirt and synthetic surfaces were compositionally similar except for fibre content (i.e. sand, silt, clay) and were managed similarly (i.e. moisture content, cushion depth). Adhesion and coefficient of friction were calculated to describe surface-hoof-horseshoe interactions. The effects of surface material (dirt/synthetic) on shear properties were assessed using ANOVA ($P<0.05$). Surface composition was also correlated with shear properties. Adhesion (30.5±9.8 N dirt; 3.5±8.4 N synthetic; LSMean ± SE) and coefficient of friction (0.37±0.02 dirt; 0.44±0.02 synthetic) were not different between dirt and synthetic surface categories; however, surfaces with more fibre content were associated with reduced soil adhesion ($r=-0.75$; $P<0.01$) and higher coefficient of friction ($r=0.81$; $P<0.01$). Surface type as a gradient with fibre content rather than surface type categories (dirt, synthetic) affected shear surface properties. This suggests that arena owners can influence shear mechanical behaviour of a surface by adjusting fibre content; however, future studies are necessary to directly determine the relationship of shear surface properties and equine musculoskeletal health.